Community composition of corals in Palau determined by a qualitative survey conducted in 2021-2022

Website: https://www.bco-dmo.org/dataset/927230
Data Type: Other Field Results
Version: 1
Version Date: 2024-05-13

Project
» Collaborative Research: How do selection, plasticity, and dispersal interact to determine coral success in warmer and more variable environments? (Palau coral selection plasticity dispersal)

Contributors	Affiliation	Role
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Abstract
Bottlenecks in the early life-history stages of corals can shape community composition across reefs. We used photographic surveys and the deployment of tiles to capture recruit, juvenile, and adult corals at 7 sites across Palau. Photographic surveys were undertaken using two methods: a qualitative biodiversity survey (2021–2022) and quantitative transects (2023). This dataset includes the results from the biodiversity survey.

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Coverage

Location: Republic of Palau
Spatial Extent: **N**:7.36722 **E**:134.55317 **S**:7.16162 **W**:134.34697
Temporal Extent: 2021 - 2022

Methods & Sampling

In this study, we took a multi-pronged approach to understand recruitment and life-history bottlenecks on coral reefs in Palau. Recruits in our study were corals collected on settlement tiles. Because tiles were deployed for intervals of weeks to months, all recruits in this study were < 6 months post-settlement. Juveniles were corals ≤ 5 centimeters (cm) in diameter observed using macro photography. While precise ages cannot be estimated, most corals < 5 cm are likely ≤ 3 years old. Adults were corals > 5 cm in diameter, including many large colonies observed using photography.

Settlement panels made from terra cotta (2018-2022) or limestone (2022-2023) were deployed at each site to collect coral recruits. Tiles were 15 x 15 cm and attached to stainless steel threaded rods embedded in the reef using clamps or zip ties. In 2018, tiles were deployed for the duration of a 2-week field season. In 2021-2023, tiles were deployed during one field season and recovered during the subsequent field season, ~6 months later. Tiles were examined using a dissecting microscope immediately following recovery. All coral recruits were

photographed, removed with a razor blade, and individually preserved in 1.5 milliliters (mL) of 95% ethanol. Photographic surveys were undertaken using two methods: (1) a qualitative biodiversity survey (2021-2022) and (2) quantitative transects (April 2023).

For the biodiversity survey, adult and juvenile corals were selected haphazardly for sampling by 2 to 4 investigators during a 45- to 60-minute SCUBA dive. The goal of the biodiversity survey was to photograph every species present at a site, so species were not photographed in proportion to their occurrence. The freeform style of the biodiversity survey allowed cryptic spaces to be investigated so a maximum number of species was observed.

For the quantitative transects, all adult and juvenile corals within 0.5 meters (m) on either side of a 10-m transect were photographed (i.e., each transect represents 10 square meters). Adult corals were photographed from an altitude of ~1 m, including overlapping photos along the length of the transect. Juvenile corals were photographed individually with detailed investigation of cryptic spaces along each transect. The quantitative transect data are included in this dataset. All transects were sampled in April 2023. See "Related Datasets" for the transect data.

Photographs were recorded using an Olympus TG-6 camera and a DSLR camera (Nikon D850) with wide-angle (adults) and macro (juveniles) lenses. Images from the biodiversity survey (n=2583 images) and the quantitative transects (n=1858 images) were viewed individually. All corals in each image were identified to genus level by reference to taxonomic guides. Coral recruits from settlement tiles were identified using the ITS2 locus. Each recruit was individually crushed with a sterile razor blade, and DNA was extracted using Chelex resin (Bio-Rad, 2018-2022) or the HotSHOT method (Truett). PCR was used to amplify the ITS2 locus, and successful PCR products were sent for Sanger sequencing (Sequegen, Worcester, MA). Sequences were compared to published sequences in GenBank using the blastn algorithm.

Data Processing Description

Four genera were excluded from analysis because their small body size and reliance on asexual reproduction made it impossible to differentiate adults from juveniles in our dataset. The 4 excluded genera were: *Cycloseris*, *Cynarina*, *Parascolymia*, and *Trachyphyllia*.

BCO-DMO Processing Description

- Created a site locations table, "site_locations.csv", using the site latitudes and longitudes provided by PI by email.
- Converted latitude and longitude values from degrees and decimal minutes to decimal degrees, and rounded to 5 decimal places.
- Imported original file "Recruit_biodiversity.csv" into the BCO-DMO system.
- Added columns for Latitude and Longitude to the primary data table by joining to the site locations table.
- Removed the "Location" and "Abbrev" columns as requested by PI.
- In Type column, replaced "Outer" with "Classical" and "Inner" with "Extreme", as requested by PI.
- Unpivoted the table to create a new column for "Genus" and a column for "Abundance".
- Saved the final file as "927230_v1_palau_biodiversity_survey.csv".

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Data Files

File	
927230_v1_palau_biodiversity_survey.csv	(Comma Separated Values (.csv), 52.50 KB) MD5:f1f63e89bfe6cc1cc2acb9c980908cee
Primary data file for dataset ID 927230, version 1	

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Related Publications

Meyer-Kaiser, KS, Bennett, M-J, Andres, MO, & Grupstra, CGB (2024) Early life-history bottlenecks shape coral community composition across classical and extreme reefs in Palau. Marine Ecology Progress Series, in review. *Results*

Schoepf, V., Baumann, J. H., Barshis, D. J., Browne, N. K., Camp, E. F., Comeau, S., Cornwall, C. E., Guzman, H., Riegl, B., Riccardo, R.-M., & Sommer, B. (2023). Corals at the Edge of Environmental Limits: A New Conceptual Framework to Re-Define Marginal and Extreme Coral Communities. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4343592
Methods

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Related Datasets

IsRelatedTo

Meyer-Kaiser, K. (2024) **Community composition of corals in Palau determined by quantitative transects sampled in April 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-05-10 doi:10.26008/1912/bco-dmo.926379.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Site	Site name	unitless
Latitude	Site latitude; positive values = North	decimal degrees
Longitude	Site longitude; positive values = East	decimal degrees
Type	Type refers to whether a site was inside a lagoon (inner or "extreme") or exposed to the open ocean (outer or "classical"). This scheme (extreme v. classical) follows a framework published by Verena Schoepf et al., 2023 (doi: 10.2139/ssrn.4343592). Extreme reefs are defined as coral reefs with higher than normal temperatures, stressful conditions, and high coral cover. Classical reefs are those exposed to the open ocean with cool/average temperatures and high coral cover.	unitless
Stage	Adult or Juvenile	unitless
Genus	Genus	unitless
Abundance	Abundance of coral of the given genus at the site	count of individuals

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Instruments

Dataset-specific Instrument Name	Olympus TG-6 and Nikon D850 cameras
Generic Instrument Name	Camera
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	terra cotta or limestone settlement panels
Generic Instrument Name	colonization substrata
Generic Instrument Description	Natural or artificial materials deployed in a marine or artificial environment for a given period to act as standardised, passive settlement sampling devices (e.g. settlement plates). They are used to determine the extent of colonization and/or the diversity of settled organisms.

Dataset-specific Instrument Name	dissecting microscope
Generic Instrument Name	Microscope - Optical
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	
Generic Instrument Name	Self-Contained Underwater Breathing Apparatus
Generic Instrument Description	The self-contained underwater breathing apparatus or scuba diving system is the result of technological developments and innovations that began almost 300 years ago. Scuba diving is the most extensively used system for breathing underwater by recreational divers throughout the world and in various forms is also widely used to perform underwater work for military, scientific, and commercial purposes. Reference: https://oceanexplorer.noaa.gov/technology/technical/technical.html

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Project Information

Collaborative Research: How do selection, plasticity, and dispersal interact to determine coral success in warmer and more variable environments? (Palau coral selection plasticity dispersal)

Website: https://www.nsf.gov/awardsearch/showAward?AWD_ID=2048589&HistoricalAwards=false

Coverage: Palauan coral reefs

NSF Award Abstract:
Coral reefs host thousands of marine species, help protect coastlines from storm damage, generate tourism, and house fish used for human consumption. However, corals are vulnerable to increasing water temperatures, which can lead to coral death. One way for reefs to survive in warming oceans is for corals that are well-suited to warmer waters to repopulate reefs that have less temperature-tolerant individuals. For this strategy to succeed, however, the more temperature-tolerant corals need to be able to disperse to and survive in these different environments. This project takes advantage of reef systems in the Pacific nation of Palau that naturally experience a wide range in temperatures across short geographic distances. Using cutting-edge

ecological and genomic techniques, the team of investigators is directly testing whether young corals from Palau’s warmest reefs can successfully be carried by ocean currents to Palau’s currently cooler reefs and subsequently survive and thrive in these habitats. Given the relevance of this research for the local ecology, the team is disseminating results to the Palauan government through a written report in conjunction with Palauan scientists who are interning with the team, and to the Palauan people through public presentations. As part of this work, the investigators are maintaining a blog and are organizing a music-lecture series combining dance, music, and science to promote awareness of the coral reef crisis across English and Spanish-speaking communities in the US. Results from this project are informing restoration and conservation practices of the Coral Conservation Consortium as well as other efforts worldwide.

A major question in evolutionary biology is how plasticity and adaptation interact to influence survival under novel environments. Understanding these processes is increasingly important as rising temperatures associated with climate change influence species globally. For marine organisms with pelagic larval phases, including reef-building corals, the post-settlement period constitutes a critical bottleneck for adaptation and plasticity, with the added complexity that the conditions experienced and time spent as larvae can incur carryover effects. This project leverages reefs in Palau that span a steep environmental gradient to study how environmental variation drives selection and plasticity and to examine if dispersal between reefs limits success across habitats due to carryover effects. The investigators are testing the overarching hypothesis that corals from warmer and more variable environments are adapted to warmer temperatures and exhibit increased plasticity, but that dispersal between reefs incurs a fitness cost. The team integrates field and molecular techniques to: 1) investigate the degree of selection occurring on warmer and more variable reefs, 2) test whether corals transplanted to more variable environments improve their thermal tolerance through developmental plasticity, and 3) examine whether delays in metamorphosis required for dispersal across reefs comes at a fitness cost due to carryover effects.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2048678

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